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MEMOIRS
OF THE
GEOLOGICAL SURVEY
OF
THE UNITED KINGDOM.

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*Figures and Descriptions*

ILLUSTRATIVE OF  
BRITISH ORGANIC REMAINS.

—  
DECADE IV.  
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BRITISH FOSSILS.

DECADE THE FOURTH.

ALL the plates and descriptions in this Decade are devoted to fossil Echinodermata of the order *Echinoidea*.

The genera selected for illustration are *Temnechinus*, *Acrosalenia*, *Hyboclypus*, *Hemipneustes*, *Ananchytes* with its section *Holaster*, and *Cardiaster*. The geological age of the first is Upper Tertiary, of the second and third Oolitic, of the remainder Cretaceous. Several of the species are represented for the first time.

Temnechinus is a genus remarkable for its species being at present known only as fossils of the Coralline and Red Crag; it is now characterized for the first time.

The examples of *Acrosalenia* selected are both remarkable for their beauty and their very perfect condition. They are also of much interest, one on account of the rectification of its true generic position, which I have been enabled to make through the aid afforded by very perfect specimens: the other, because of the complete preservation exhibited by the specimens described of parts too often lost in fossil Echinoderms. I have appended to the descriptions of these *Acrosalenia* brief characters of some new species of this interesting oolitic genus.

Hyboclypus is illustrated by the finest and largest species of the genus, one discovered during the researches of the Geological Surveyors.

Hemipneustes, to which genus I unite *Toxaster*, is now for the first time authentically represented by a British example, remarkable for its novelty and for the light it throws upon the mutual affinities of those genera of *Echinoidea* which have excentric mouths.

The well known genus *Ananchytes* is combined (as indeed it was formerly by Lamarek) with *Holaster*. In selecting the common *Ananchytes ovata* of the Chalk for the subject of a plate and description, I have been influenced by the necessity of clearing up the confused synonymy of this fine fossil, and of settling the numerous spurious species which have been constituted out of its varieties, or from imperfect figures contained in old works.

Cardiaster is a new genus, lately constituted by myself for some remarkable and interesting sea-urchins, intermediate in their characters between *Ananchytes* and the true *Spatangida*. To the account of the species figured I have added notices of all the forms of this curious type which are known to me as British.

EDWARD FORBES.

October, 1852.

BRITISH FOSSILS.

DECADE IV. PLATE VI.

ANANCHYTES OVATA.

[Genus ANANCHYTES. LAMARCK. (Sub-kingdom Radiata. Class Echinodermata. Order Echinoidea. Family Ananchytidae.) Body suborbicular; oblong or obscurely cordate, tumid; with homogeneous ambulacra, convergent on the vertex, all plane or with the anterior ambulacrum in a shallow furrow. No fascioles. Vent terminal, marginal or supra-marginal. Apical disk elongated and composed of four perforated genital and five perforated ocular plates. Tubercles perforate; their bosses crenulate. Spines minute. No dental apparatus.

Subgenus ANANCHYTES. Body ovate or orbicular; vent infra-marginal.]

DIAGNOSIS. *A. ambitu ovato seu orbiculari, antice rotundato; testâ altâ tumidâ, ano infra-marginuli.*

FORMA α , *alta, hemispherica, ambitu ovato.*

ANANCHYTES OVATA and CONOIDEA, Auctorum.

FORMA β , (*alta*) *elongata, superne depressa, ambitu ovato.*

ANANCHYTES STRIATA, Auct. ? OVATA pars.

FORMA γ , *alta superne depressa, ambitu orbiculari.*

ANANCHYTES GIBBA, Agassiz.

FORMA δ , *subglobularis.*

FORMA ϵ , *alta, conica.*

ANANCHYTES CONICA, Agassiz. A. PYRAMIDATA, Portlock.

SYNONYMS. *Echinocorys vulgaris*, BREYN. Sched. de Echinis. p. 58. pl. 3., f. 1. 2. (1722.)

Echinocorytes ovatus, LESKE ap. KLEIN. Nat. Disp. Echin. p. 178, pl. 53, f. 3., also *Echinocorytes pustulosus*, p. 180, pl. 16, f. A. B. *Echinocorytes scutatus*, p. 175, pl. 15. A. B., and pl. 42, f. 4. *Echinocorytes minor*, p. 183, pl. 16, C. D., and 17, a. b. (1778.)

Echinus ovatus, scutatus and pustulosus, Linnæus.

Ananchytes ovata, striata, gibba, pustulosa and semiglobus LAMARCK. An. sans Vert. vol. iii., p. 25, 27.

Ananchytes ovata, conoidea, striata, gibba, pustulosa, hemisphærica, semiglobus and corculum. C. DESMOULINS, Etudes sur les Ech., p. 368-376.

Ananchytes ovata, gibba, striata, Gravesii? semiglobus and conica. AGASSIZ. Cat. Syst., and AGASSIZ and DESOR, Cat. Raisonné des Echinides, in Ann. des Sciences Nat. 3d series, Zoologie, vol. viii. p. 30.

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Ananchytes ovata. GOLDFUSS, Petref. Germ., p. 145, pl. 44, f. 1. BRONN, Lethæa, t. 29, f. 23. HISINGER, Leth. Succ. p. 93, t. 26, f. 3. GEINITZ, Grundriss der Verst., p. 332, t. 22, f. 19. CUV. and BRONGN. Geol. Paris, p. 15 and 390, pl. 5, f. 7. A. B. C. MANTELL, Medals, p. 349. lign. 79. PORTLOCK, Rep. Geol. Londonderry, &c., p. 354, pl. 17, f. 3. and 18, f. 2. PICTET, Traité Elem. vol. iv. pl. 5, f. 3. AGASSIZ, Echin. Suis. 1., p. 30, pl. 4, f. 9, 4, 6, (var. *conica*). SISMONDA, Ech. Foss. Nizza., p. 13. ROEMER, Nord. Deutsch. Kreide Geb., p. 35.

Ananchytes striata. GOLDFUSS, Pet. Germ., p. 145, plate 44, fig. 3, a. f. GRATELOUP, OURS. Foss., p. 60, pl. 2, f. 9.

Ananchytes conoidea. GOLDFUSS, Pet. Germ., p. 148, pl. 44, f. 2, a. b. c. GRATELOUP, OURS. Foss., pl. 2, f. 8.

Ananchytes hemisphærica. CUV. and BRONGN, Geol. Paris., p. 390, pl. 5, f. 8, A. B. C.

Ananchytes corculum. GOLDFUSS, Pet. Germ., p. 147, pl. 45, f. 2, a. b. c.

Echinites scutatus. SCHLOTHEIM, Petref. p. 319.

Echinocorys scutatus. PARKINSON, Org. Rem. vol. iii. pl. 2, f. 4.

Echinocorys scutatus ovatus. MANTELL, Geol. S. E. Eng. p. 373.

Ananchytes cretosus. MANTELL, Wonders, p. 311, t. 52, f. 5.

Galea ovatus. SMITH, Strat. Syst. p. 21. Upper Chalk Plate, fig. 10.

After many attempts to frame a concordance of the synonyms of this well known Echinite, I have been obliged to give up in despair, and even to displace their chronological order. In the above catalogue, which might be swelled to three times its dimensions by useless references to mere mentions of this species, I have placed in first rank the references to Breyn and Leske, since to them, and especially to the figures of the last-named author, all subsequent writers refer back. Next in order I have placed the references (in lump) to Lamarck, Desmoulins, and Agassiz, authors who have given catalogues of species, and whose lists in this case, according to my views, resolve themselves into a multiplicity of names for the varieties of one thing, names too which cannot be well reconciled with each other. Lastly, follow references to authors most of whom have given original figures of the species, in one variation or other, ranked in general in order of importance of quotation rather than priority of date. All the figures cited in these synonyms are preceded by a very good representation given by Dr. Plot in his Natural History of Oxfordshire (1677), delineating a flint cast of one of the ordinary forms of this Echinite.

It is to be regretted that the original appellation given to this fossil by Breyn, who styled it *Echinocorys vulgaris*, and figured it much better than Leske did, was not retained. Now,

however, it is best for the convenience of science to preserve the Lamarckian name *Ananchytes ovata*, although originally given to one of the varieties only. Lamarck's names seem to be little better than so many designations for Leske's figures, not one of which, in this instance, deserves to be separated from the others as the type of a distinct species.

Goldfuss gave admirable representations of what seemed to him to be three or four distinct specific types, and applied to them in two instances the names used by Lamarck.

Agassiz and Desor admit eight species of *Ananchytes*, using the generic term in its most restricted sense. As all but two of these are types of which good figures are published, and as I consider all of them, except *sulcata*, to be probably varieties of one species, it is desirable that a few critical remarks should be made upon the list given by the distinguished naturalists just mentioned.

For *Ananchytes ovata* (Lamarck) they refer to Goldfuss's figure designated by the same name. This is my *Forma* α , and may be considered as the normal type of the species. The figure in Leske's work referred to by Lamarck as the representation of his *ovatus* is not exactly this, but one of the connecting links between my *Forma* α and *Forma* ε . The *Ananchytes corculum*, judging either from the old figures of Leske or the excellent ones of Goldfuss, is, it seems to me, the young of this form. I have received under the MS. name of *Ananchytes Bayfieldi* a similar young specimen. Portlock's first examples of *Ananchytes ovata* are of the normal type.

The second species in the "Catalogue Raisonné," *Ananchytes gibba* (Lamarck), is identified by Agassiz and Desor with the *A. rustica* of DeFrance, and for a figure they refer to *A. striata* var. *subglobosa* of Goldfuss; that figure represents an example of my *Forma* γ ; not, however, of the extreme type of that variation, but rather of a specimen inclining towards *Forma* β . The figure in Leske, referred to with a query by Lamarck, is still more near β , or rather is between β and α .

The third species in the "Catalogue Raisonné" is *Ananchytes striata* (Lamarck). In collections, full-bodied, long-topped, and comparatively smooth-sided *Ananchytes* are usually labelled with this name. *Ananchytes conoidea* and *striata* var. *marginata* of Goldfuss are referred to it; the former is a lofty example of my variation β , the latter a specimen intermediate between β and α . The *A. conoideus* of Portlock is truly this form; the *A. hemisphærica*

of Brongniart is intermediate between it and the normal type. The *A. pustulosa* of Lamarck, founded on a figure by Leske, should surely rather be referred to a specimen intermediate between α and ε , and nearest α .

The fourth species, *Ananchytes Gravesii* of Desor, has never been figured or described at length, but from the brief note concerning it I think it may prove to be a form intermediate between β and δ .

The fifth, *A. tuberculata*, Defrance, is probably truly distinct.

The sixth, *A. semiglobus* (Lamarck), seems to be an intermediate form between α and ε . The figure in Leske is that of a young α .

The seventh, *A. conica*, Agassiz, has its extreme form in *pyramidata* of Portlock, and its variation passing into the normal type through the *Ananchytes ovata* figured in Part I. plate 4, figs. 4-6, of the *Echinodermes Suisses*.

The abundance of this *Ananchytes* in our Upper Chalk, and the fine state of preservation in which they are usually found, has enabled me to examine minutely and compare a great number of specimens; an inquiry the more desirable, as, according to some naturalists, and those of high repute, there are many species of the strict *Ananchytes* type, allies of *A. ovata*, whilst the experience of British collectors would rather incline in favour of the view that we have but a single species, exhibiting numerous variations. To this last view I feel compelled to assent, for however distinct the forms termed *ovata*, *gibba*, *striata*, *semi-globus*, *conica*, &c., may seem when selected and contrasted in the cabinet, every one of them is linked with the others by the most delicate shades of gradation. Neither in degree of elevation, rotundity, flatness of base, or curve of back, smoothness or roughness, can I find any constant character. Scarcely two individuals out of more than a hundred examples now before me exhibit the same proportions.

The specimens vary in outline of base from ovate or oblong to nearly round, and in outline of back from that of a depressed oblong hemisphere to an abruptly-sided pyramid. They vary also in degree of granulation of surface, in the number of primary tubercles, and in the height of the ambulacral and interambulacral plates. The number and proximity of pores in the avenues increase with age.

In a well-grown adult example, above $2\frac{1}{2}$ inches in height, the dorso-lateral plates of the ambulacra are between 40 and 50 in number, and of the inter-ambulacra about half that amount. In a specimen 1 inch $\frac{1}{2}$ in height the number of the ambulacral plates is under 30, and of the inter-ambulacrals half that amount. The

differences in the number of the plates of the inferior surface are not so great.

The ambulacra are, dorso-laterally, at about the centre of the sides, in breadth to the interambulacra as 1-3. This proportion varies a little in different specimens, but without much regard to the general contour. Except in size, they exactly resemble the ambulacrals. On the upper third of the test they are small, short, and closely set; then gradually become taller down the sides and as they approach the margin. They and the interambulacrals are similarly ornamented with minute scattered primary tubercles, each of which is perforated and set upon a boss with a crenulated summit. On a large interambulacral plate in one of the rougher varieties I have counted as many as fifty tubercles, and yet they appear wide apart. The interspace is studded with scattered miliary granules forming imperfect rings around the tubercles. In an individual of one of the smoother varieties there may not be more than about fifteen tubercles upon the corresponding plate. The pairs of pores occupy each an ambulacral plate, and are placed near its centre, slightly oblique, a very shallow groove connecting the one pore with the other. In consequence of their closeness they are conspicuous near the apical disk, but are inconspicuous on the sides.

The base varies in degree of flatness, and specimens are occasionally found remarkably rounded at the margins; usually, however, it presents an extensive flattened surface. At one extremity of it is seen the longitudinally elliptical vent, near the other the transversely oval mouth. The space between the mouth and vent is plane, and occupied by the subanal plates of the posterior interambulacral segment. There are about six of these plates in each alternate row, and their inner margins are curved hindwards. They are covered with tubercles, thickly set, and consequently contrasting with the bordering inferior ambulacral plates, which are minutely granulated but not tuberculated, and present the aspect of a lanceolate rough space or elongated escutcheon, the base of which is formed by a raised ovate leaflike space in front of the vent, marking the position of internal buttresses. The tubercles on the anterior portion of this space are smaller than those of its hinder half and than those of the escutcheon that embraces it. They are also more scattered, and are more separated by minute granules. The postero-lateral ambulacrals in their basal portion are elongated to reach the mouth, and their plates become longer and somewhat

polygonal, so that the pores are more distant than they are on the sides and margin. The other ambulacra, in consequence of the exceedingly excentric position of the mouth, near which they widen out, are much shortened and close set below, and the pores of all five in the immediate neighbourhood of the mouth form a sort of irregular star, the longest rays of which are formed by the buccal extremities of the antero-lateral ambulacra. The mouth is lodged in an oblique depression; its lips are thickened; the hinder one is highest, but does not overlap. The vent is set obliquely and sub-marginally.

The apical disk is much elongated. It is composed of four large and perforated genital plates (the fifth is usually obsolete) and five large oculars; of the two anterior genital plates, the right one is the largest, in consequence of its including the madreporiform body in its constitution. This organ is not conspicuous, but under the lens its punctations, which are exceedingly minute, may be detected. Of the two hinder genital plates, the left one is largest. They are all polygonal. Of the ocular plates, the two antero-laterals are much larger than the other three plates. The eye perforations are marginal; the genital holes sub-central. All the plates are thickly covered with granules and bear a few tubercles. On flint casts the position of the central portion of the apical disk is marked by a space included within an oblong groove. This groove is caused by the impressions of the walls of a solid oblique tube-like body projecting from the inner surface of the apical disk into the cavity of the test, and directed backwards. This organ appears to me to be the sand canal, and is connected with the madreporiform plate. On flint casts the pores of the avenues are seen strongly projecting, and on each side of the vent is a shallow groove marking the place of internal strengthening buttresses.

The following table exhibits the comparative measurements in inches and the configuration of the dorsal contour, in seventeen examples, all differing strikingly from each other.

Specimen.	Height.	Length.	Breadth.	Form of hinder dorsal inter- ambulacral area.	Contour of the dorsal surface.
1	$2\frac{4}{12}$	$3\frac{2}{12}$	$2\frac{10}{12}$	Rounded -	Very wide and flattened.
2	$2\frac{7}{12}$	$3\frac{2}{12}$	$2\frac{7}{12}$	Carinated -	Wide and flat.

Specimen.	Height.	Length.	Breadth.	Form of hinder dorsal inter ambulacral area.	Contour of the dorsal surface.
3	$2\frac{6}{12}$	$3\frac{6}{12}$	3	Carinated -	Wide and rather flat.
4	$2\frac{5}{12}$	$3\frac{6}{12}$	$2\frac{9}{12}$	Carinated -	Wide and very flat.
5	$2\frac{6}{12}$	$3\frac{2}{12}$	$2\frac{4}{12}$	Much carinated and elevated.	Gently declining from apex.
6	$2\frac{5}{12}$	$2\frac{4}{12}$	$2\frac{2}{12}$	Rounded -	Gently curving.
7	$2\frac{3}{12}$	$2\frac{8}{12}$	$2\frac{3}{12}$	Carinated -	Gently curving.
8	$1\frac{1}{12}$	$2\frac{1}{12}$	$2\frac{5}{12}$	Carinated -	Flattened slightly.
9	$1\frac{7}{12}$	$2\frac{5}{12}$	$1\frac{10}{12}$	Carinated -	Flattened.
10	$1\frac{1}{12}$	$2\frac{6}{12}$	$2\frac{1}{12}$	Carinated -	Gently curving, and slightly flattened.
11	$2\frac{1}{12}$	$2\frac{4}{12}$	$2\frac{1}{12}$	Carinated -	Curving.
12	$2\frac{3}{12}$	$2\frac{8}{12}$	$2\frac{3}{12}$	Carinated -	Flattened.
13	$2\frac{3}{12}$	$3\frac{1}{12}$	$2\frac{7}{12}$	Carinated -	Rapidly curving, and flattened behind.
14	$2\frac{2}{12}$	$2\frac{1}{12}$	$2\frac{5}{12}$	Sub-carinated	(Tumid below, and) Conic above.
15	$2\frac{5}{12}$	$2\frac{10}{12}$	$2\frac{3}{12}$	Carinated -	(Tumid below, and) Conic above.
16	$1\frac{8}{12}$	$1\frac{9}{12}$	$1\frac{6}{12}$	Carinated -	Conical, with slightly curved sides.
17	$2\frac{2}{12}$	$2\frac{6}{12}$	$1\frac{9}{12}$	Sub-carinated	Pyramidal, with straight sides.

The last specimen in this table is the original example of *Ananchytes pyramidata* of Portlock, and the most extreme of all the varieties.

Locality and Geological Position. *A. ovata* is a characteristic fossil of the White Chalk, and is found abundantly in the south-east of England, especially in Kent, Surrey, Sussex, and the Isle of Wight. It occurs in both middle and lower parts of the series. *Forma* δ *subglobularis* and β *striata* are prevalent in the Lower Chalk. In

Ireland Colonel Portlock observed *Forma a ovata* to be characteristic of the lower beds there. In England that variety is chiefly from the upper beds. All the varieties occur as flint casts among gravel.

Specimens with slightly tumid plates from County Derry in Ireland were referred by Portlock to the *Ananchytes sulcatus* of Goldfuss, a Maestricht species. They are, however, unquestionably only peculiar examples of *A. ovatus*. The supposed British *Hemipneustes radiatus* recorded by Dr. Mantell is only *Ananchytes ovatus*, as the original examples in the British Museum show.

EXPLANATION OF PLATE IV.

- Figs. 1. 2. and 3. Different views of an example of the common *Forma a*.
 Fig. 4. *Forma e pyramidatus* from the original specimen.
 Fig. 5. A very unsymmetrical example of *Forma i*.
 Fig. 6. A similar example more tumid in outline.
 Fig. 7. A subglobular specimen, *Forma d*.
 Fig. 8. A much elongated example of *Forma b*.
 Fig. 9. A very elevated example of *Forma g*.
 Fig. 10. The plates of the apical disk.
 Fig. 11. The interior impressions of the apical disk as seen upon a flint cast, showing the furrow indicating the position of the base of the sand canal.
 Fig. 12. Ambulacral and interambulacral plates from near the apex.
 Fig. 13. Similar plates from the sides.
 Fig. 14. Tubercles and granules of the upper surface.
 Fig. 15. Tubercles and granules of the lower surface.

October, 1852.

EDWARD FORBES.

